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Fractionation of brewer's spent grains by acid pretreatment under mild conditions

**INMACULADA ROMERO¹, José Antonio ROJAS¹, ENCARNACIÓN RUIZ-RAMOS¹, CRISTÓBAL CARA¹,
SOLANGE MUSSATTO², EULOGIO CASTRO¹**

¹ UNIVERSIDAD DE JAÉN, Spain

² Technical University of Denmark, Denmark

Biomass generated from brewery industry constitutes a by-product yearly generated in big amounts with scarcely economic feasible applications [1]. Brewer's spent grain (BSG) is formed mainly by the residual components of barley malt and includes most of the barley grain shells and minor fractions of the pericarp and endosperm fragments [2]. This agro-industrial residue does not compete with food use and it can serve as a feedstock for second-generation ethanol production [1].

The aim of this work is to solubilize the hemicellulosic fraction of BSG leaving a cellulose-rich solid to be hydrolysed by enzymes. This hemicellulosic sugar solution could be later fermented to produce ethanol using unconventional microorganisms capable of assimilating both pentoses and hexoses. BSG was washed and characterized according to the NREL (National Renewable Energy Laboratory) methodology. BSG characterization determined 52% carbohydrate and 26% protein. In order to achieve high yields of fermentable sugars recovery, BSG was pretreated with sulfuric acid in an autoclave at different conditions (temperature, sulfuric acid concentration, and process time). The highest overall sugars yield was reached at 130 °C, 3% H₂SO₄ and 15 min pretreatment time. These conditions allowed the fractionation of this biomass and more than 90% of hemicellulosic sugars were recovered in the prehydrolysate. Thus, a solution with 44 g/L of hemicellulosic sugars (50% xylose and 25% arabinose) and low level of inhibitory compounds was obtained. Phenolic compounds were identified in this prehydrolysate and its antioxidant capacity was determined according to different methods, DPPH and β -carotene. Likewise, a cellulose-enriched solid (38% cellulose content) highly digestible was obtained after pretreatment. This pretreated solid yielded 89 g glucose/100 g glucose in pretreated BSG by enzymatic saccharification that corresponds to 75.4 g glucose/100 g glucose in original BSG.

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